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## Kinetics of the reaction of Fe-II(EDTA) with oxygen in aqueous solutions

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Supplementary material belonging to:

**An Experimental Study on the Kinetics of the Reaction of Fe<sup>II</sup>(EDTA) with  
Oxygen in Aqueous Solutions**

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4. The effect of salinity on the solubility and mass transfer coefficient of oxygen

## Absorption profiles

A typical absorption profile for a decreasing pressure experiment using  $\text{N}_2\text{O}$  is given below.

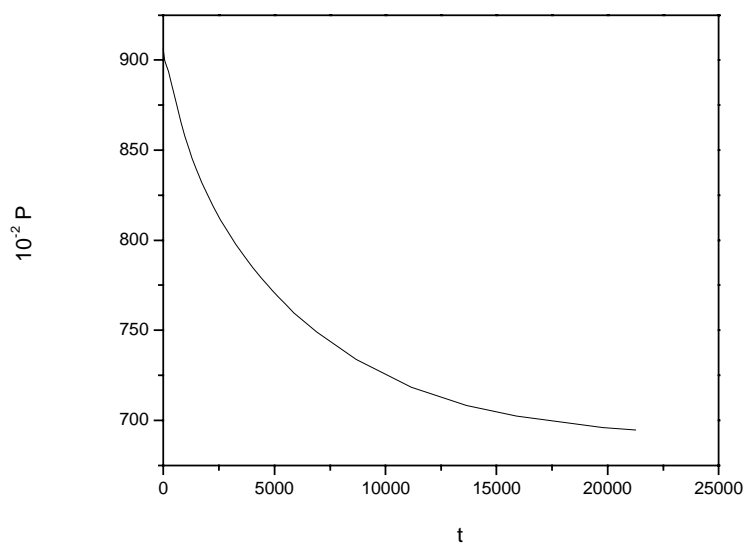


Figure 1. Absorption profile of  $\text{N}_2\text{O}$  in an aqueous  $\text{Fe}^{\text{II}}(\text{EDTA})$  solution.  $T = 328 \text{ K}$ ,  $C_{\text{Fe}^{\text{II}}(\text{EDTA})} = 60 \text{ mol/m}^3$ ,  $P_{\text{N}_2\text{O}}^0 = 90580 \text{ Pa}$ .

## 2. Determination of the effect of salts on the solubility of gases

The effect of salts on the solubility of gases may be estimated using the following relation:

$$\log\left(\frac{He_{salt}}{He_w}\right) = \sum (h_i + h_G) \cdot C_i^{ion} \quad (1)$$

where  $h_i$  is a ion specific parameter,  $h_G$  a gas specific parameter and  $C_i^{ion}$  is the concentration of ions <sup>1</sup>. This equation can be used in the temperature range 273 - 363 K with the correction of the gas specific parameter in the following way:

$$h_G = h_{G,0} + h_T (T - 298.15) \quad (2)$$

where  $h_{G,0}$  is the reference parameter and  $h_T$  is the gas specific parameter for the temperature effect.

Combining eq. (1) for O<sub>2</sub> and N<sub>2</sub>O allows the elimination of the unknown values of  $h_i$  <sup>2</sup>:

$$\log\left(\frac{He_{O_2}}{He_{O_2w}} \frac{He_{N_2Ow}}{He_{N_2O}}\right) = \left[ (h_{G,0,O_2} - h_{G,0,N_2O}) + (h_{T,O_2} - h_{T,N_2O})(T - 298.15K) \right] \sum_i^{N_i} C_i^{ion} = \log A_G \quad (3)$$

The  $h_{G,0}$  and  $h_T$  were taken from the literature <sup>1</sup>. For an ion concentration up to 1500 mol/m<sup>3</sup>,  $A_G$  is 1.03 at 293 K and 1.05 at 333 K <sup>2</sup>.

### 3. The effect of pH on the solubility and mass transfer coefficient of oxygen

The measured  $He_{O_2}$  in  $Fe^{II}(EDTA)$  solutions at different pH's is provided in Fig. 2.

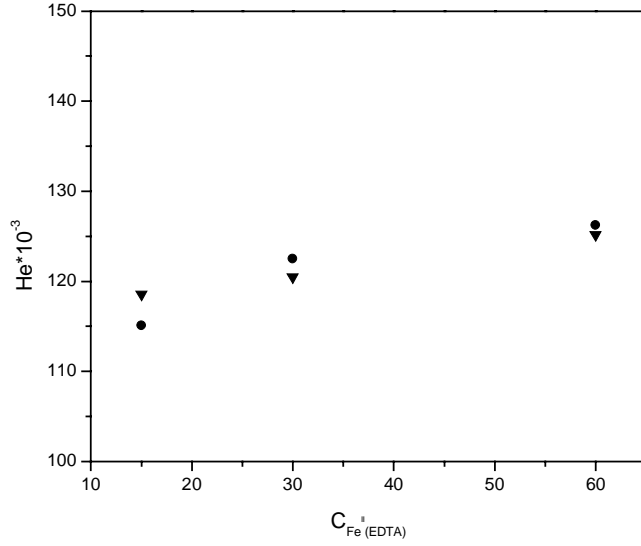


Figure 2.  $He_{O_2}$  in  $Fe^{II}(EDTA)$  solutions.  $T = 328$  K,  $P_{N_2O}^0 = 40$  kPa.  $\bullet$ : pH = 8;  $\blacktriangledown$ : pH = 5.

As expected, the  $He_{O_2}$  increases with  $C_{Fe^{II}(EDTA)}$ . However, a clear effect of the pH on  $He_{O_2}$  is absent. The effects of the pH on the  $k_L$  in  $Fe^{II}(EDTA)$  at 328 K were determined experimentally. A significant effect of the pH was absent.

#### 4. The effect of salinity on the solubility and mass transfer coefficient of oxygen

A number of physical absorption experiments using  $\text{N}_2\text{O}$  were performed to address the effects of salinity on the  $k_L$  of oxygen ( $C_{\text{FeII(EDTA)}} = 50 \text{ mol/m}^3$ ,  $T = 328 \text{ K}$ ) and the  $\text{He}_{\text{O}_2}$ .  $\text{He}_{\text{O}_2}$  was determined at different concentrations of dissolved salt (0 - 15  $\text{kg/m}^3$ ). The Henry coefficient was rather insensitive to the salt concentration in the concentration range applied. We therefore applied an average  $\text{He}_{\text{O}_2}$  value of  $2.3 \cdot 10^5 \text{ Pa} \cdot \text{m}^3 \cdot \text{mol}^{-1}$  in the calculations. The  $k_L$  values were calculated and the results are given in Fig. 3. Apparently,  $k_L$  decreases when increasing the salt loading, in line with an observed reduction of the  $D_{\text{O}_2}$  at higher salt concentrations<sup>3</sup>. In this study, the  $D_{\text{O}_2, \text{w}}$  decreased up to 5 % when increasing the salt concentration from 5 to 16  $\text{kg/m}^3$ .

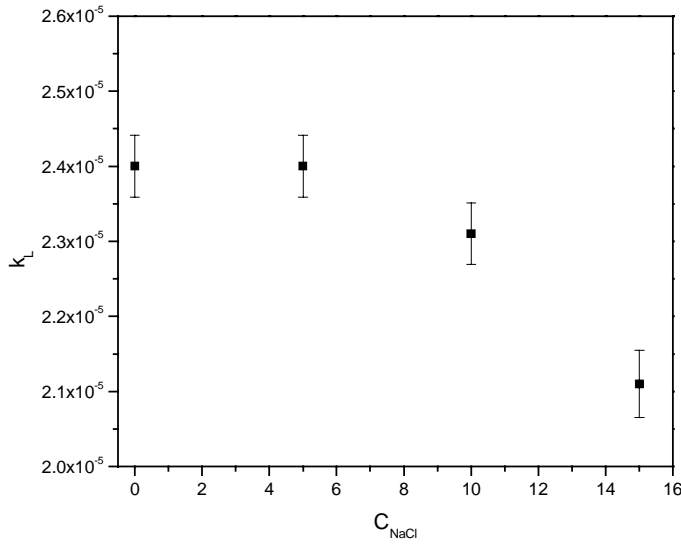


Figure 3.  $k_L$  of oxygen as a function of the concentration of  $C_{\text{NaCl}}$  at  $T = 328 \text{ K}$ ,  $C_{\text{FeII(EDTA)}} = 50 \text{ mol/m}^3$  and  $\text{pH} = 7$ .

## References for supplementary material

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